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pivot-guns is, that the gun may be kept considerably lower down, and still have as much elevation as may be considered necessary. The first figures represent a gun of the exact height required for a port; but for steam-vessels the slider f may be placed very near the deck; and instead of having the wooden transom c to rest on, a broad iron plate may be substituted, the ends of which are suited to receive the rollers $z z$, as shewn in fig. 16, which is an inner view of a carriage so lowered. Through this plate the pivot may be placed.

No. IX.

IMPROVEMENTS IN SHIPS' RUDDERS.

The LARGE SILVER MEDAL was presented to Captain JOHN LIHOU, R.N., for his improvements in Ships' Rudders, a Model of which has been placed in the Society's Repository.

28th April, 1834.

HAVING in 1823 suffered much from an accident which occurred to the rudder of a ship I then commanded, it appeared to me that rudders were most improperly hung; and in 1829 I obtained a patent for an improvement in the rudder-hangings of ships.

Since that period my attention has been chiefly directed to the perfecting of that important governing agent, the rudder itself; the usual form, construction, and fitting of which seemed not less faulty than was the method of hanging rudders previous to my patented invention. I

have, therefore, whilst employed in his Majesty's dock-yards to superintend the fitting of ships according to my plan, introduced an improvement wherever I found a defect; and that my endeavours to improve rudders have been in some degree successful will, I trust, be made evident by the model, drawings, and description, which you will herewith receive.

It may be proper to observe, that my Lords Commissioners of the Admiralty now adopt these unpatented improvements co-extensively with my rudder-hangings; that is to say, in the cases of ships of war either being built or undergoing extensive repair; and my inventions having been so highly approved in the navy, I am induced to believe that they may be found not less important to the commercial marine. If I am justified in that belief as fully as in my desire of giving to the commercial part of the community any benefit which these improvements may tend to produce, it is certain that my purpose cannot better be effected than through the means of the Society for the encouragement of Arts, Manufactures, and Commerce, to which, for a knowledge of many important inventions, the marine of this country is already most deeply indebted.

The improvements I have to submit to the Society may be comprised under the following heads:—

1st.—An altered form and fastening of the woodlock—that piece of wood by the inletting of which the rudder is prevented from rising or being unshipped by means of any force acting in a vertical direction.

2nd.—An improved form of the sternpost.

3d.—The application of a towing-strop and chain to the head of the rudder, as a safeguard; and also the placing of a beam, furnished with eye-bolts, to plumb the

said towing-strop, for the purpose of readily shipping or unshipping the rudder; and,

1st. — As regards the woodlock : I have found the usual means of fastening it with spike-nails driven through the bearding and into the rudder highly objectionable ; because its removal, in cases of sudden necessity for unshipping the rudder, is thereby rendered always a matter of great difficulty, and often of danger. A striking proof of this is given by Captain Lynn, of the Hon. East India Company's service, in an appendix to his valuable star tables ; the facts being expressed in the following words, extracted from the log-book of the Company's ship *Duke of Buccleugh* :—" The greatest difficulty we had to encounter (in order to unship the rudder) was to get the woodlock out, which one of the people volunteered to do ; and, to the astonishment of every person on board, effected, although the ship was dipping her counter in repeatedly. He was often washed off during the operation, but he performed the task, by the help of a crow-bar ; being carefully slung himself, and attended by his anxious and admiring shipmates."—To obviate such difficulty and danger, I slightly dove-tail the lower part of the woodlock (as shewn in its proper place, in the piece of rudder, fig. 17, Plate II., and separate in figs. 18 and 19, in each of which figures the dove-tail is represented at *a*) ; and for securing it to its place in the rudder, I use two keel-staples, as shewn at *b b*, fig. 17, in their places, and the form of one is represented in fig. 20. These staples can be readily drawn by means of a claw-hammer ; but, in case of need, they may be cut, or sawn through, at the seam of the woodlock and rudder, part of which is gouged or hollowed out a little for introducing the claw, as shewn above the staples in fig. 17. The time

occupied in removing this woodlock, under any circumstances, could not exceed a minute.

2dly.—With regard to the improved form of the sternpost, it is necessary to premise that formerly ships' stern-posts and rudders invariably presented salient angles to each other, called their *beardings*. The principal objection to this form is, the obvious difficulty of producing, when afloat, that nice coincidence of the angular points throughout their whole extent which is indispensable in shipping the rudder. Within these latter years, however, a grooved sternpost has been generally used, particularly by steam-vessels; consequently this great difficulty in shipping the rudder was removed, but not without introducing the new objection of large gullettings, or very deep cuttings into the rudder; besides which, as only very narrow edges were left on the sternpost, in the case of a ship being taken aback, and acquiring much sternway, the rudder, having then a great tendency to fly athwart, might do so; and the tiller, being thus forcibly driven against its block, or the ship's side, would become the first obstacle to the greatest possible change of position in the rudder, and sustaining, as it must, a violent shock, from having to oppose all the resistance of the water brought suddenly on the back or afterside of the rudder, it is to be apprehended that the tiller would break. The strain falling, then, on the narrow edges of the sternpost, those weak parts might yield to the great pressure, and subject the ship not only to loss of rudder, but also to damage of the sternpost. It seemed therefore desirable that the dimensions of the grooving in the sternpost should be reduced, and that the rudder should be made to correspond therewith, so as to preserve all the advantage of the grooved sternpost in guiding the rudder to its place; together

with the advantage of smaller gullettings, and the best effect of the planes inclined to each other on the rudder and sternpost (called beardings), which was that of proving, in case of need, a stop, or limit, to the movement of the rudder, by meeting at all points throughout their extent. That this combination of good effect has been produced will be made evident by reference to figs. 21, 22, and 23. The improved small grooving and corresponding part of the rudder are in each figure marked *cc*; and the beardings, or planes, still left on the sternpost and rudder are marked *dd*. These planes, when the helm is amid-ship, being inclined to each other in an angle of about forty degrees, as formerly, limit the motion of the rudder each way to that angle; and in case of great sternway forcing the rudder to either side, their meeting must limit the strain brought on the rudder-hangings to the effect of the force or pressure of water acting upon the rudder at that angle; whereas, the narrow edge of a deep and large grooving might in such case break away, and then the rudder would probably fly to a very different angle with the keel. It might, in short, be ultimately twisted away from the sternpost.

That no loss of strength or waste of timber accrues from my plan of grooving the sternpost will appear on mere inspection of fig. 24, which is the transverse section of a piece, intended for a sternpost. The lower dotted lines *dd* represent the beardings according to the old plan, and the triangles standing upon them shew the waste or loss that must arise from thus shaping the timber. The black lines and the curve *c* shew the sectional form of the sternpost according to my plan; and the superficial contents of the two very small triangles which stand on the black lines, plus the small part *c* of

the circular segment, being compared with the contents of the two greater triangles standing on the dotted lines dd , it will be evident, that in the conversion of the timber according to my plan less waste accrues; consequently, strength is attained.

3dly. —Hitherto rudders have been frequently lost, when suddenly unshipped (through striking on a rock, or the hangings otherwise getting broken), in consequence of the rudder-chains being fastened to the horns fig. 25. The chains thus fastened, although chiefly intended for steering in the event of the tiller being damaged, and for yielding relief to the rudder, tiller, and hangings, in bad weather, have, strange to say, been hitherto the only means, in such cases, of attaching the rudder to the ship for towing it, and preventing its total loss; but being fastened so far from the head of the rudder, when a ship had much way through the water, the unshipped rudder was not towed end foremost, but was kept at a considerable angle with the direction of the ship's progress; or, in sea phrase, "it was towed almost broadside on;" and the resistance was so much increased by that improper position, that the chains almost invariably broke, and the rudder disappeared. The rudder-chains, so disadvantageously fastened, being made of gun-metal, are, besides, very liable to snap; and iron chains, though better adapted as to strength, would, if fastened near to the copper, corrode so rapidly as to be soon unfit for any purpose. These circumstances considered, I thought it advisable no longer to depend upon such inadequate means for saving a rudder when unshipped, but, either in addition thereto, or in lieu thereof, to place at the head of the rudder a stout iron towing-strop f , fig. 26, with an iron chain attached; which chain being always inboard, and the end fastened,

would prevent the rudder from sinking when unshipped, and tow it "end on" until it could be conveniently got upon deck for repair. A towing-strop, with two ring-bolts (as in figs. 22 and 27, having a chain to each ring-bolt), is now used for the larger class of ships; and a simple strop (as in fig. 26), is employed for smaller vessels. A towing-strop of either kind, being placed on the head of the rudder, would, I perceived, afford also great facility in shipping and unshipping the rudder upon all occasions, if employed as the means of suspension for such purposes, instead of the clumsy mode hitherto used for hanging or unhangng rudders, particularly on board large ships. The strop and chains were found to answer the purposes intended on board all classes of ships; and this latter use of them led me to another improvement connected with the rudder. In laying the beams of the deck next above the rudder head, it rarely, if ever, occurred, that one of them was placed so immediately over it as to be convenient for the suspension of the rudder in hanging or unhangng; and the practice was to cut a hole or scuttle in the deck, so as to lash a block there to spars which were placed fore-and-aft, in order to divide the strain between the beams which they crossed. This being attended with loss of time and inconvenience, I have introduced the plan of placing a beam *g*, fig. 25, furnished with two eye-bolts at *h*, being so situated as nearly to plumb the towing-strop, and serve for fastening the block or pulley employed in shipping and unshipping the rudder. This beam, should the weight of the rudder require it, can be readily supported by upright pieces, or shores.

Such are the improvements to be submitted to the consideration of the Society; and,

I am, Sir, &c. &c.

JOHN LINCOLN.

P.S. As some peculiarities, in addition to the improvements above described, will be found in the model sent herewith, it may be well to state, that, in order to make it more extensively useful and worthy of acceptance, I have endeavoured to combine therein, with my own inventions, the most approved of those which I have seen employed in his Majesty's service for the improvement of rudders; and, therefore, it seems necessary to add, that the hinges, or hangings, of the rudder are made according to the plan for which I have obtained a patent, and which I need not describe, except by stating that the pins about which the rudder moves are not, as in common hangings, part and parcel of the braces, and cast in one piece with those half-hinges, or braces, which fix on the rudder. When so cast, those parts of the hinges, or hangings, are liable to invisible flaws in the crown, or bulky part of the braces, then called pintles, and of which the conical pins projecting downwards formed an important part. The pins invented by me are cast separately, and are adapted to holes in the crown of the braces that fix on the rudder, being fastened therein by a stud. Instead, too, of being conical, according to the old plan (as in figure 15), they are accurately-turned cylinders. Thus, three serious defects, which have occasioned loss of rudders, ships, and lives, are obviated:—

1st. The danger of weakness from concealed defect at the crown, or point of union between the pins and rudder-braces.

2d. The total inutility of the rudder-braces when the pins are broken off.

3d. The great evil of conical-shaped pins, which, when broken, often remained fixed in the goings of the braces, rendering useless those halves of hinges affixed to the

sternpost, which were immersed,—this occurrence making the discharge of cargo and docking of ships frequently indispensable when they put into port through loss of rudder.

It should be observed, that loss of rudder has always arisen from, or been attended with, breaking of the pins at or near the crown of the braces; and such accident always rendered the recasting of the broken braces, or recourse to a foundery, requisite; but, according to my plan, the pins will be found to break before the braces can be injured. The braces, too, will be as useful as ever when the pins are broken, and the ship being provided with spare pins can easily repair and re-hang her rudder at sea. The parts of the accurately-turned cylindrical pins which are broken off will slip easily through the googings and be lost, leaving the googings clear and ready for use. The pieces which remain in the braces that are fastened to the rudder, upon its being hoisted on board, may be got out by either taking off the braces, or removing the pieces of wood which bear upon them. On the spare ones being put into their places, the rudder is prepared for re-shipping. The remaining novelties of the model are not connected with my inventions; but the head of the rudder, it will be seen, is so short as to admit of being covered by a scuttle,—a plan now general in round-sterned ships, preserving the level of the deck for the better use of the stern guns. The upper mortice, or that adapted to receive the spare or iron tiller, is therefore placed in a movable spindle of iron, removable at pleasure; and, indeed, it is never placed until the spare tiller is required. By thus shortening the head of the rudder, and adjusting it to work round the centre of the pins, the use of the old cumbrous rudder-casing is

superseded, and the helm-port, or opening in the centre, where the rudder-head enters, is so reduced, that the old dangerous rudder-coat of canvass or leather—a very insufficient barrier to the breaking through of seas and swamping of the ship—is now dispensed with, and wood-work, called canting, is substituted.

In the rudder of the model, regard has been had to that which is deemed the best shape, and also to the best disposal and adaptation of the timber usually employed in forming rudders. Thus, in the fore-part, where deep cutting or gulleting is required, elm is preferred. The main piece is of oak; and, in order to give buoyancy to the whole, the backing-piece, or after-part, is of fir.

No. X

STRENGTHENING THE TOP-SIDES AND DECKS
OF SHIPS.

The LARGE GOLD MEDAL was presented to Mr. WILLIAM HOOKEY, 6 Prospect Place, Lower Road, Deptford, for his Method of Strengthening the Top-sides and Decks of Ships; a Model of which has been placed in the Society's Repository.

THE different pieces that compose the frame of a ship are in equilibrium only when the vessel is floating in calm water; but at sea a ship is exposed to the partial action of forces which have a strong tendency to disunite the

CORRIGENDA IN FIRST PART OF VOL. L.

- Page 11, 5 lines from bottom, for height, and place the connecting bar g, read height and place, the connecting bar g.*
- 13, *line 2, for ; then unclamp read , first unclamping.*
- 14, *5 and 8, for b read l.*
- *16, for lie read lies the bar.*
- 26, *8, after grs. add of morphia.*
- 33, *16, dele working.*
- 39, *3, for latter read former.*
- *10, after to add air and.*
- 53, *8, 11, 27, 31, for bar or bars read arm or arms.*
- *14, for 2 read 1.*
- 55, *21, dele subsequently.*
- 57, *14, dele and.*
- 58, *3 from bottom, for c c, which is a front, read which is a front view, c c.*
- 59, *5 from bottom, dele thrown back and, and insert the same in the next following line, after compartment.*
- 63, *5, for covered read high-pressure.*
- 69, *5 from bottom, for right angles read the angle.*
- 84, *9, after horns insert e.*
- 86, *12 from bottom, dele (as in figure 15).*
- 90, *1 and 2, omit alternate.*
- *6, omit half the planks retain their original thickness, and.*
- *9, omit half.*
- 91, *6 from bottom, after separate add in perspective.*
- , *last line, after Fig. 1 add the two other arms of this knee are horizontal, and at right angles to each other, one of them being parallel to the side of the ship, and the other perpendicular to it.*
- 99, *last line, for 1 read 2.*
- 100, *line 1, for 2 read 1.*
- 108, *6 from bottom, read the first part of this sentence as follows :*
A straight bar projects from the hinder part of the plate f, and to this is attached a crank g in such a position that the end of its lower arm shall move vertically whenever the bar attached to f is moved horizontally.
- 109, *4, for ring, twice repeated, read swivel.*
- 110, *23, for the sentence the weight to end of g, substitute the weight l on the spindle i balances the spiral m, the weight o on the crank balances the copper plate and horizontal bar, and another weight at the right hand end of the bar g (not shewn in the engraving), balances the weight of the wire.*
- 144, *4, after entire add machine.*
- 155, *11 from bottom, for shave read have.*